



Forest Health Note

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## Spring 2003 Sudden Oak Death Detection Survey in Washington State

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### Summary

*Phytophthora ramorum*, the causal agent of “sudden oak death” (SOD), is responsible for widespread tree mortality in central and northern California. Western Washington is at high risk for SOD due to the presence of known SOD hosts in the natural environment, suitable climatic conditions (extended periods of moist weather and mild temperatures), and the presence of nurseries receiving known SOD host stock. Between June 1, 2003 and July 10, 2003, Washington DNR surveyed 33 nurseries (125 transects) and 5 general forest sites (20 transects). One hundred and eight foliage samples were collected from known (and potential) SOD hosts including *Rhododendron* spp., bigleaf maple, Douglas-fir, evergreen huckleberry and Pacific madrone. The samples were tested by the Washington State Department of Agriculture using DAS (Double Antibody Sandwich) ELISA kits. All of the samples tested negative for *P. ramorum*.

### Introduction

*Phytophthora ramorum*, the cause of “sudden oak death (SOD),” is responsible for widespread tree mortality in central and northern California. Since its discovery in 1995 on tanoak in Marin County, California, SOD has spread to 12 counties in California, a small area near the town of Brookings, Oregon, and in the spring of 2003 was detected in a nursery in the Puget Sound lowlands of Washington.

The USDA Forest Service recently completed a risk assessment pertaining to SOD. Based on the number of susceptible hosts, climatic conditions and locations of nurseries receiving SOD host stock, western Washington is considered to be at high risk for this disease. The objective for this survey was to gather information on the distribution of SOD in the high-risk zone of Washington.

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Sudden Oak Death received its name because of the devastation it has caused on tanoaks, coast live oaks, and other members of the black oak family (*Erythrobalanus*) in California. At this point in time, it is not known to affect members of the white oak family (*Lepidobalanus*), including Oregon white oak, which is the only oak native to Washington. The current list of susceptible host species that are native to western Washington includes rhododendron, Douglas-fir, bigleaf maple, vine maple, Pacific madrone and evergreen huckleberry. Although these species are the only western Washington hosts currently recognized, new host species are being identified as susceptibility trials continue.

## Biology

*Phytophthora ramorum* is a fungus-like organism that can infect a wide range of host species. The organism produces microscopic reproductive, dispersal and survival structures making definitive field identification of the disease impossible. Sporangia are the reproductive structures of the organism and are known to play a significant role in spreading the disease. Sporangia may germinate and directly infect plants, but more importantly, they can produce and release zoospores. Zoospores are motile spores (spores with two flagella) that swim in free water and infect plants through wounds or succulent plant tissue. Sporangia are often found on the foliage of hosts and are generally spread by rain splash, or aerially, to new hosts. Chlamydospores are survival structures that can endure months of adverse conditions and germinate when suitable conditions are present. All three structures require free water for germination. Chlamydospores are often present in the soil surrounding infected plants and can be transported with soil on shoes, tires, animal paws/hooves, etc. aiding in long-range dispersal of the organism. Spores can also be transported in stream water.

## Symptoms

Symptoms caused by *P. ramorum* vary among host species. *Phytophthora ramorum* primarily infects the leaves of *Rhododendron* spp., although it can also infect branches and may kill entire plants. Infection causes brown-black (necrotic) lesions on portions of the leaf often where water accumulates. The lesions have a diffuse margin and can mimic drought injury. *Phytophthora ramorum* can cause similar symptoms on Pacific madrone and may also cause leaf spots, necrosis along the midvein of the leaf, leaf death, and branch dieback. Bigleaf maple and vine maple are foliar hosts of *P. ramorum* and symptoms tend to look like scorch starting at the edge of the leaf and with irregular margins that do not follow the contour of the leaf. Occasional leaf spots have been identified on evergreen huckleberry, but branch dieback is a more common symptom. *Phytophthora ramorum* causes small lesions on twigs or stems of evergreen huckleberry resulting in death of the infected branch or stem beyond the lesion. *Phytophthora ramorum* also causes cankers on small branches of Douglas-fir resulting in tip dieback, which looks very similar to frost damage. It is important to note that abiotic stressors such as drought and frost, as well as other biological agents, can produce symptoms similar to those caused by *P. ramorum* in the above hosts. Only laboratory analysis of symptomatic tissue can confirm the presence of *P. ramorum*.

## Methods

The sampling protocol utilized in this survey was developed by the Forest Health Monitoring group within the USDA Forest Service. In forested areas around nurseries that contained suitable host types, four 100-m long transects were distributed along the nursery perimeter so as to sample all available aspects (Fig. 1). The transects encompassed the edge of the forested area along the nursery perimeter and extended 10 meters into the forested area (Fig. 1).

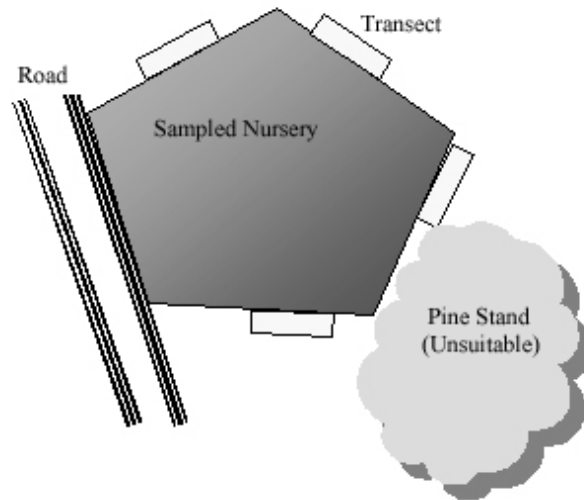


Figure 1. Sampling protocol for nursery perimeter surveys.

In high-risk forest environments, not adjacent to nurseries, a plot center was located at least 100-m from a road. Four 100-m transects, each 10-m wide, were installed on cardinal azimuths from the plot center. A Global Positioning System (GPS) was used to identify starting and ending coordinates for each transect.

Along each transect rhododendron, evergreen huckleberry, bigleaf maple, Douglas-fir, Pacific madrone and other known hosts were examined for symptoms of SOD. Samples of species not currently recognized as hosts were collected if they exhibited symptoms similar to those exhibited by known hosts because of the likelihood that there are unidentified hosts that will be listed as susceptible in the future. Symptomatic leaves were placed in labeled plastic bags and delivered to the laboratory, usually within the same day. The samples were tested by the Washington State Department of Agriculture using DAS (Double Antibody Sandwich) ELISA kits.

## Results and Discussion

The forested perimeter of 33 nurseries, including 125 transects with suitable hosts, were surveyed for SOD (Fig. 2). The absence of a suitable forested perimeter limited the number of

transects completed on some nurseries. Twenty transects in five forested areas were surveyed for SOD (Fig 2.).

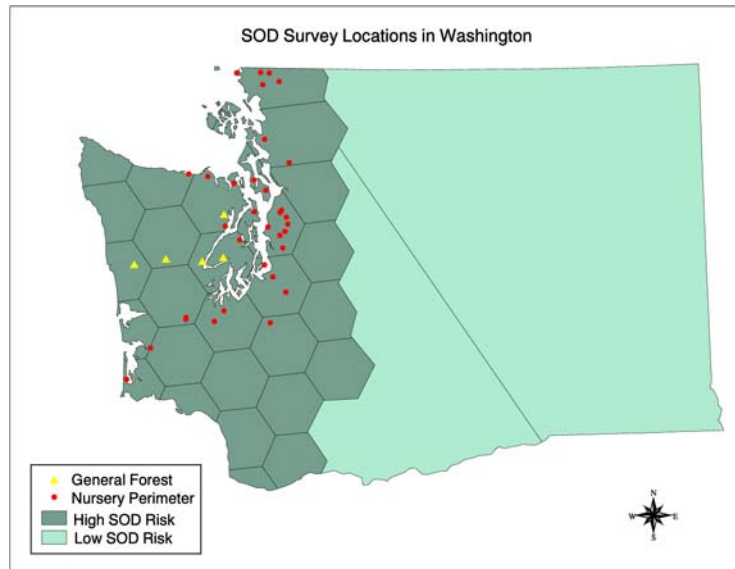


Figure 2. Location of nursery perimeter and general forest SOD survey sites within USDA Forest Service SOD risk polygons.

*Phytophthora ramorum* was not isolated from any of the 108 samples collected (Table 1). *Rhododendron* spp. were the most common species sampled, followed by bigleaf maple and vine maple (Table 1).

Table 1. Species of samples collected from SOD survey locations and the results of the *Phytophthora ramorum* analysis.

Species	Number of Samples	<i>P. ramorum</i> +/-
<i>Rhododendron</i> spp.	38	-
Big Leaf Maple	19	-
Vine Maple	14	-
Douglas-fir	10	-
Evergreen Huckleberry	10	-
Pacific Madrone	6	-
Northern Red Oak	4	-
Tanoak	2	-
Redwood	1	-
Salal	1	-
Magnolia	1	-
Exotic Maple (spp. ?)	1	-
Camellia	1	-

A late frost in the Puget Sound caused the wilting of many succulent tips on Douglas-fir, which mimicked the symptoms of SOD.

While SOD has been found in one nursery in the Puget Sound lowlands, there is no evidence that the disease has spread beyond the confines of that nursery. Infected plants within the nursery were destroyed to prevent further spread of the pathogen. The organism was brought to the Washington nursery on plants received from an infected nursery in Oregon. There is no evidence that the organism has spread naturally in the environment from California, or Oregon, to Washington.

Current research indicates that there are two strains of *P. ramorum*. One strain found in the forests of California and Brookings, Oregon is referred to as the “California strain”. The other strain found in nurseries in northern Oregon, Washington, British Columbia and Europe is referred to as the “European strain”. While the “California strain” has been found to spread naturally in the environment, the “European strain” has spread from nursery to nursery on infected stock. There is no evidence of natural spread of the “European strain” outside of the nurseries in the United States. However, it is likely that some infected nursery stock had been distributed to the public prior to SOD detection in the nurseries. The distribution of infected plant material to the public gives rise to the potential for the pathogen to become established in the natural environment.